

REMARKS

Entry of this Amendment in accordance with the provisions of 37 CFR § 1.114 is respectfully requested.

This Amendment is in response to the final Office Action dated January 20, 2004. By the present Amendment, each of the independent claims has been amended to clarify the invention, as will be discussed below.

Also by the present amendment, the drawings have been amended in response to the requirement to do so set forth in the Notice of Draftsperson's Patent Drawing Review.

Briefly, the present invention, as defined by the claims, is directed to the particular features of the present invention for improving the formation of spray areas for injected fuel in an arrangement utilizing a fuel swirling mechanism. Referring first to Fig. 2, solely for purposes of example, which shows an overall cross-sectional view of the lower portion of a fuel injector in accordance with the present invention, a fuel injection hole 101 is shown which includes an inner wall 201. As discussed on page 5, paragraph 22, a rotating element such as shown by 107 is provided with a rotational groove to generate a fuel swirl. As noted on page 7, paragraph 28, the inner wall 201 of the injection hole 101 is coated with sheets of the swirled fuel which flows downward in a swirled fashion along this inner wall. The features of the present invention are particularly directed to providing an arrangement for restraining the radial spreading of the swirled fuel in certain directions while permitting the radial spreading of the swirled fuel in other directions.

Fig. 3 provides an overall view of an embodiment of the invention which can achieve the desired effects. As shown in the embodiment, a pair of passageways

are formed between walls 204a and 205a and between walls 204b and 205b. As can be seen in Fig. 3, and noted on page 6, paragraph 24, the passageway created by the walls 204a and 205a can be narrower than the passageway created between the walls 204b and 205b.

Fig. 4 provides a more detailed view of the arrangement of Fig. 3. As can be seen in Fig. 4 (and as described on page 7, in paragraph 29), the area between the points 404 and 407 and the area between the points 405 and 406 serves as a restraint means to restrain the radial spread of the swirled fuel coming through the injection hole. It is noted that the wall structure to provide the restraint means and passage means is located downstream of the injection hole. As particularly noted on page 7, paragraph 29, if the wall height of the restraining means (that is, the wall between points 405 and 406 and the wall between 404 and 407) is of a sufficient height, it can restrain virtually all fuel from being radial spread between these points.

On the other hand, release areas having widths of W_a and W_b are provided where the radial spread of the swirled fuel takes place with a large amount of fuel flow. This is discussed, for example, on page 8, paragraph 31 of the specification. As such, by adjusting the widths of the release areas and the heights of the restraint areas, excellent control can be achieved over the spray patterns obtained from the swirl fuel.

Reconsideration and allowance of amended independent claims 1 and 4 and their respective dependent claims over the cited reference to McKay (USP 4,790,270) is respectfully requested. By the present Amendment, each of the independent claims has been amended to clearly define the combination of means for generating a swirl flow to the fuel located at an upstream end of the injection hole

in combination with restraint means for retraining the radial spread of the swirled fuel, with the restraint means being located downstream of the fuel injection hole. It is respectfully submitted that the primary reference to McKay completely fails to teach or suggest these features.

More specifically, the McKay reference is not directed to any arrangement for creating a swirl flow at a location upstream of the fuel injection hole. Although the Office Action states that McKay teaches a flow restraining means that includes component for generating a swirl flow, referring to Fig. 11, it is respectfully submitted that Fig. 11 does not show any means for generating a swirl flow located upstream of the fuel injection hole. Similarly, there is nothing in McKay which would suggest restraining the radial spread of such swirled fuel downstream of the fuel injection hole, particularly since McKay has no equivalent for generating the swirled fuel upstream of the injection hole in the first place. Therefore, it is respectfully submitted that the amended independent claims 1 and 4 and their respective dependent claims clearly define over the cited reference to McKay, and reconsideration and allowance of these amended claims is respectfully requested.

Entry and allowance of new claims 8 and 9 is also respectfully requested. These new claims define similar features to claims 1 and 2, but set forth these features in a more structural manner without the use of means plus function limitations. As such, like claims 1 and 2, claims 8 and 9 clearly define a relationship between an upstream fuel swirl generator and downstream restraint walls which restrain the radial spread of the swirled fuel. As such, claims 8 and 9 also clearly define over the cited referenced to McKay for substantially the same reasons discussed above regarding claims 1 through 7. Accordingly, consideration and

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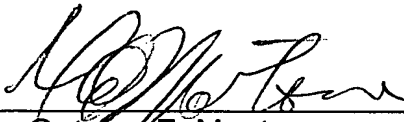
allowance of claims 8 and 9, together with claims 1 through 7, is respectfully requested.

If the Examiner believes that there are any other points which may be clarified or otherwise disposed of either by telephone discussion or by personal interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Antonelli, Terry, Stout & Kraus, LLP Deposit Account No. 01-2135 (Docket No. 503.40884X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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FIG. 8

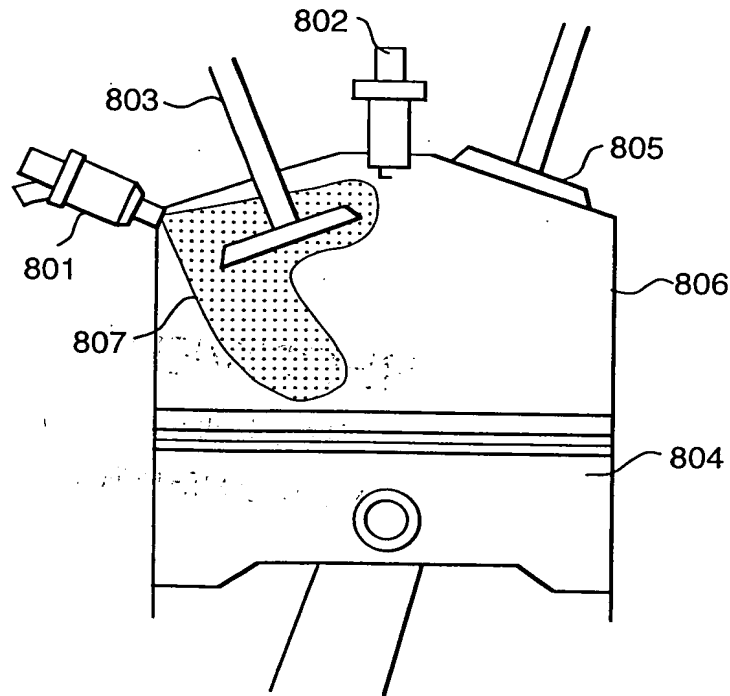


FIG. 9(a)

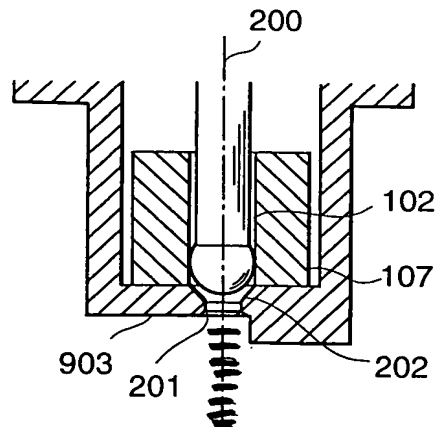
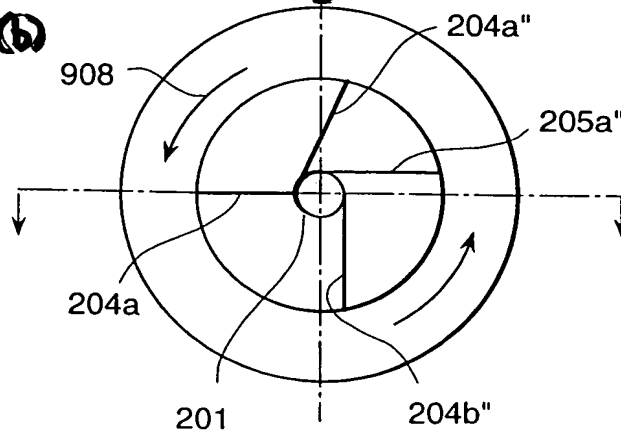


FIG. 9(b)



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FIG. 10

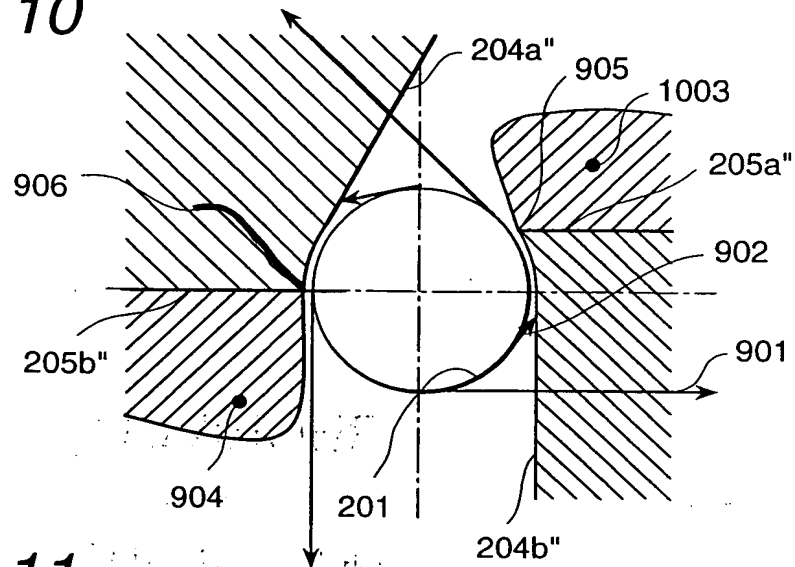


FIG. 11

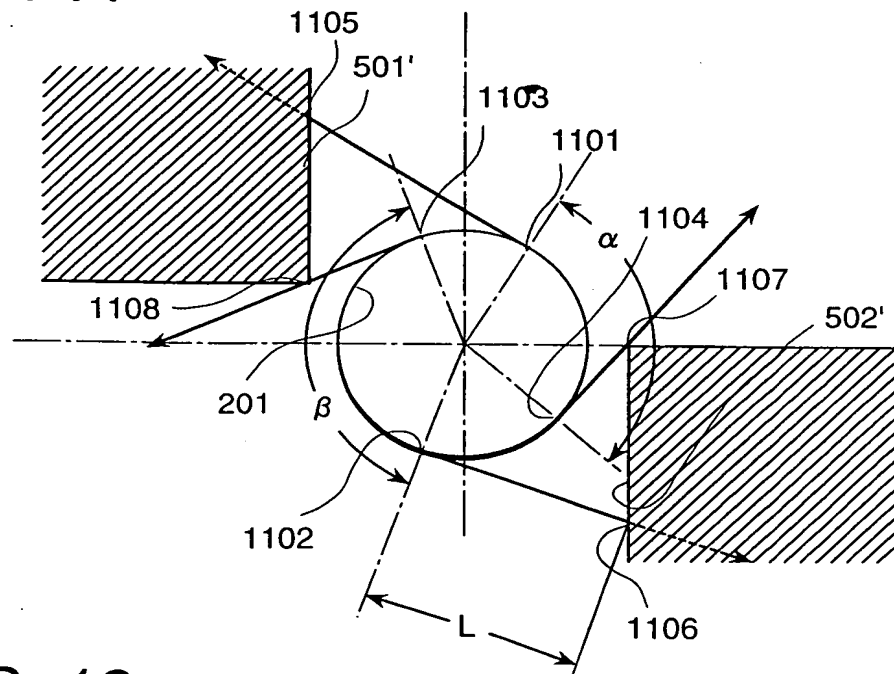


FIG. 12

